REMARKS

Applicants have amended Claims 1, 7-11, 20, and 22-24. Basis for the amendments can be found in the specification and originally filed claims, specifically page 6, lines 6-11. Claims 1-25 are pending in the present application. Claims 1-11 and 13-15 stand rejected. Claims 16 and 20-25 have been allowed. Claims 17-19 have been withdrawn from consideration.

The Examiner is thanked for the courtesies extended to Applicants' representative during a telephone interview held on March 28, 2001. During this interview the references cited by the Examiner were discussed. No agreement was reached.

Reconsideration is respectfully requested in light of the following amendments and remarks. The following remarks are believed to be fully responsive to the outstanding Office Action and render all claims at issue patentably distinct over the references cited.

35 U.S.C. §103

The Examiner has rejected Claims 1-6, 8, 9, 14 and 15 under 35 U.S.C. §103(b) as being unpatentable over Anderson et al. (U.S. Patent No. 5,527,628). Applicants respectfully traverse this rejection and request reconsideration. It is believed that all of the originally filed claims are patentably distinct over the cited reference.

A claim is unpatentable over a prior art reference only if the reference teaches or suggests *all* the claim limitations. Applicants submit that the Anderson reference does not teach or suggest all the elements of the present claims. Specifically it does not teach or suggest methods

for producing an *in-situ* composite solder by heating the solder components to a temperature greater than the highest melting temperature of any of the individual components. The Anderson reference teaches a eutectic solder that is formed by mixing together the individual elements of the solder, heating the mixture and cooling in a waterbath. Although the solder of the Anderson reference has an intermetallic phase, the definition of a eutectic solder is that this intermetallic phase disappears upon heating the solder and then reforms upon cooling. In contrast, the solder of the present invention is a composite solder. A composite solder comprises a solder alloy to which an intermetallic compound has been added. The solder of the present invention is formed by mixing the components of the intermetallic compound with an *already formed* solder. For example, the solder of the Anderson reference may be used to form the composite solder of the present invention. In further contrast to the eutectic solder of the Anderson reference, the intermetallic compound of the composite solder of the present invention does not disappear upon melting of the solder, but remains as a discrete intermetallic compound. In an effort to expedite prosecution of this case, but in no way conceding to the validity of the rejection, Applicants have amended claims 1, 7-11, 20 and 22-24 to replace the term "intermetallic phase" with "intermetallic compound". Applicants submit that the amended claims distinctly claim a method for producing a composite solder having a discrete intermetallic compound. Furthermore, there is no suggestion or motivation in the Anderson reference to produce a composite solder from the disclosed eutectic solder.

The Examiner has also rejected Claim 7 under 35 U.S.C. §103 as being unpatentable over the Anderson reference in view of Gibson et al. Applicants respectfully traverse this rejection

and request reconsideration. It is believed that all of the originally filed claims are patentably distinct over the cited references.

As discussed above, the Anderson reference does not disclose, suggest or motivate the present invention, particularly methods to produce an *in-situ* composite solder having an intermetallic compound. The Gibson et al. reference does teach a composite solder having 20 volume % intermetallic compound with improved fatigue resistance. However, the Gibson et al. reference is not enabling because, like the Anderson reference, it does not teach or suggest a *method* for making such a solder. Therefore, neither the Anderson reference or the Gibson et al. reference, alone or in combination, teach or suggest a method for producing an *in-situ* composite solder comprising a step of rapidly cooling the non-solid composite solder mixture.

Finally, the Examiner has rejected Claims 10,11 and 13 under 35 U.S.C. §103 as being unpatentable over the Anderson reference in view of U.S. Patent No. 5,520,752 to Lucey, Jr. et al. Applicants respectfully traverse this rejection and request reconsideration. It is believed that all of the originally filed claims are patentably distinct over the cited references.

Neither the Anderson reference nor the Lucey reference teach, suggest or motivate methods for producing an *in-situ* composite solder with the step of rapidly cooling a heated, non-solid mixture of a solder and the components of an intermetallic compound at a rate of at least 100 °C/sec. The Lucey reference discloses methods for forming the intermetallic compound before it is added to the solder by various methods. Col. 3, line 64 to col. 4, line 5. These intermetallic compounds are then mixed with either paste or bulk solder to form a composite

solder without any melting. Col. 4, lines 24-26. The mixture of solder and intermetallic compound are not heated to form a non-solid and then cooled to produce the composite solder but are mixed together as discrete solids. In contrast, the methods of the present invention do not preform the intermetallic compound, but form it *in-situ* in the solder by mixing together the individual components that make up the intermetallic compound with the solder, then heating the mixture to form a non-solid and rapidly cooling the mixture to form the composite solder with the intermetallic compound. By way of non-limiting example, to produce the composite solder of the Lucey reference, a Cu_6Sn_5 intermetallic compound is mixed with solder without heating. In the present invention, elemental Cu and elemental Sn are added to a solder in ratios that will give Cu_6Sn_5 upon forming the *in-situ* composite solder.

Applicants thus submit that neither the Anderson, Gibson or Lucey references, either alone or in combination, teach or suggest the methods of the present invention for producing an *in-situ* composite solder. Neither would one skilled in the art, upon reading the references, be motivated to produce an *in-situ* composite solder using the methods of the present invention. Applicants therefore request withdrawal of the rejection.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present

application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

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By: Barbara S. Gibbs

Barbara S. Gibbs, Ph.D.
Reg No. 44,708

Monte L. Falcoff
Reg No. 37,667

Harness, Dickey & Pierce, P.L.C.
P.O. Box 828
Bloomfield Hills, Michigan 48303
(248) 641-1600

Attorney Docket: 6550-000013
Serial No. 09/114,665

ATTACHMENT FOR AMENDED CLAIMS

1. (Thrice Amended) A method for producing an *in-situ* composite solder having particulate reinforcements of an intermetallic [phase] compound comprising the steps of:

a) combining a solder with the components of the intermetallic [phase] compound to form a mixture;

b) heating the mixture of step a) to a temperature greater than the highest melting temperature of any of the individual components of the intermetallic phase to form a non-solid;

c) rapidly cooling the mixture of step b) at a rate of at least about 100 °C/sec.

7. (Amended) The method of Claim 1 where the components of the intermetallic [phase] compound comprise about 20 volume % of the composite solder.

8. (Amended) The method of Claim 1 where the intermetallic [phase] compound comprises one of the elements of the eutectic solder and a transition metal.

9. (Amended) The method of Claim 1 where the intermetallic [phase] compound comprises Cu_6Sn_5.

10. (Amended) The method of Claim 1 where the intermetallic [phase] compound comprises Ni_3Sn_4.

11. (Amended) The method of Claim 1 where the intermetallic [phase] compound

comprises $FeSn_2$.

16. (Twice Amended) A method for producing an *in-situ* composite solder having particulate reinforcements of an intermetallic [phase] compound comprising the steps of

a) combining a solder with the components of the intermetallic [phase] compound to form a mixture;

b) heating the mixture of step a) to form a non-solid;

c) cooling the non-solid mixture of step b) to form a solid;

d) heating the solid of step c) to form a non-solid; and

e) rapidly cooling the mixture of step d).

20. (Amended) A method for producing an *in-situ* composite solder having particulate reinforcements of an intermetallic [phase] compound comprising the steps of:

a) combining a solder with the components of the intermetallic [phase] compound to form a mixture;

b) heating the mixture of step a) to form a non-solid;

c) cooling the mixture of step b) to form a solid;

d) reheating the mixture of step c) to form a non-solid; and

e) rapidly cooling the mixture of step d) at a rate of at least about 100 °C/sec.

22. (Amended) The method of Claim 20 where the components of the intermetallic [phase] compound comprise about 20 volume % of the composite solder.

23. (Amended) The method of Claim 20 where the intermetallic [phase] compound comprises one of the elements of the eutectic solder and a transition metal.

24. (Amended) The method of Claim 20 where the mixture is reheated to a temperature greater than the melting point of the intermetallic [phase] compound.